Understanding beach monitoring

Iowa Department of Natural Resources

2004

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Definitions for words in **boldface** throughout this guide are located in the glossary on page 11.

Beach monitoring in Iowa: a history

Most Iowans pick a lake for recreation because of its level of water quality, according to a recent study by Iowa State University*.

Survey respondents in the study ranked water quality as the most important factor in choosing a lake for recreation and ranked safety from bacteria contamination/ health advisories as the most important characteristic in a lake.

To maintain and improve water quality at beaches across the state, DNR monitors water quality at beaches throughout the swimming season.

Iowa beach monitoring began in 2000, when the new Beaches Environmental Assessment and Coastal Health Act (BEACH Act) required states with coastal or Great Lakes beaches to begin monitoring those waters.

While Iowa is one of 20 states not required under the BEACH Act to monitor, the DNR understood the need to develop its own comprehensive beach monitoring program.

Testing water at Lake Ahquabi in Warren County.

Quick Facts

*   The DNR began monitoring bacteria levels at 31 state park beaches in 2000

*   Program expanded to include 35 state-owned beaches in 2001 and all 37 state-owned beaches in 2003

*   Program expanded again in 2004 to include 35 of Iowa's 58 county-run beaches, after a number of those beaches expressed interest in monitoring

*   The DNR adopted a beach policy in 2001 to determine if swimming should be recommended

*   **Drowning is the greatest risk** associated with swimming in natural bodies of water

*   A risk also exists for contracting a waterborne illness from contaminated waters

*   **There have not been any outbreaks of a waterborne illness associated with Iowa state park beaches**

*   A risk does **not** exist for eating fish from beaches with high bacteria levels

*   Surrounding states monitor fewer sites than Iowa, according to research conducted in 2002 by Janice Boekhoff, a research geologist with the DNR's water monitoring section

*Azevedo, C.D., Egan, K.J., Herriges, J.A., & Kling, C.L. (2003). The Iowa Lakes Valuation Project: Summary and Findings from Year One.

Understanding the process

How are samples collected?
Trained staff members from the University of Iowa Hygienic Laboratory take weekly samples from three locations along each state-owned beach and at three water depths (ankle-, knee- and chest-deep). These nine samples are mixed together to create a composite sample, which is sent to the lab to be analyzed. Samples are taken for most beaches from May 24 to Oct. 31, 2004. Some state-owned beaches monitor only from the week before Memorial Day to Labor Day (please see page 8 for a listing). County beaches will sample from Memorial Day through Labor Day.

What does monitoring test for?
The lab tests state-owned beaches for **fecal indicator bacteria** in the water, namely *E. coli* and enterococci bacteria. This bacteria itself will not make swimmers sick — in fact, the bacteria normally live in the digestive tracts of humans and animals. County beaches will only test for *E. coli*.

What does it mean to find *E. coli?*
The presence of *E. coli* suggests that some amount of fecal matter is in the water and that pathogenic microbes may be present. It is these **pathogens**, not the indicator bacteria, that can cause waterborne illnesses. Measuring the amount of *E. coli* in the water can be used to determine the health risk to swimmers.

Why doesn't the *E. coli* make swimmers sick?
The strain of *E. coli* that the DNR tests for at beaches differs than the strain of *E. coli* that can make people sick, such as the strain that can contaminate meat. The *E. coli* tested for at Iowa beaches only indicates that there may be pathogens in the water that could cause illness.

How long does the process take?
The current testing process takes several days to get results. After collecting the sample, bacteria must be allowed to grow for one day, then the bacteria must be counted and re-counted before information is entered into a database.

When is there a problem?
Because of the delay in getting test results, a **one-time high sample** isn't a large cause for alarm. However, if the **geometric mean sample** is high, it can signal a chronic problem. The geometric mean is calculated similar to an average, using a formula developed by the U.S. Environmental Protection Agency with five separate samples equally spaced over a 30-day period.

When is a swimming advisory posted at a beach?
State-owned beaches that exceed Iowa's geometric mean water quality standard for bacteria will be posted with "swimming is not recommended" signs. County beaches will decide independently whether or not to post advisory signs.

State-owned beaches designated as "**vulnerable**" that exceed the one-time limit for bacteria will immediately post a swimming advisory sign. Beaches in the "**less vulnerable**" category will post a swimming advisory sign if samples taken over two consecutive weeks both exceed the one-time limit.
Please see Page 8, "Differences between beaches," for more information on "vulnerable" and "less vulnerable" beaches.

Reading and interpreting the results

E. coli counts from all state park beaches and 35 county beaches are posted weekly at www.iowadnr.com/news/beach.html.

The **one-time maximum standard** is 235 colony-forming units of *E. coli* bacteria per 100 mL of water.

If five samples, equally spaced over a 30-day period, have a **geometric mean** higher than 126 colony-forming units per 100 mL of water, the **geometric mean standard** has been exceeded. Any state-owned beach will post a swimming advisory sign when the geometric mean standard is exceeded.

If a state-owned beach has had a history of high results in the past (at least one year with a high geometric mean), it is considered a "**vulnerable**" beach. These beaches are posted with a swimming advisory immediately when there is a one-time maximum high.

State-owned beaches not in the "vulnerable" category will post advisory signs only when samples taken over two consecutive weeks both exceed the one-time maximum standard. These beaches are sometimes referred to as "**less vulnerable**."

Beach Monitoring Test Results: July 28 and July 29, 2003	
Beach	**E.coli**
Backbone beach	40
Beed's Lake beach	90
Big Creek beach	<10
Black Hawk beach	36
Blue Lake beach	10
Brushy Creek beach	<10
Clear Lake beach	<10
Crandall's beach	<10
Emerson beach	10
Geode beach	460
George Wyth beach	1100
Green Valley beach	120
Gull Point beach	20
Lacey-Keosauqua beach	260
Lake Ahquabi beach	10

A sample of monitoring results from 2003.

County beaches will decide independently whether or not to post swimming advisory signs.

How to read results

Using the monitoring test results in the box to the left as an example, learn how *E. coli* counts are used to determine if a swimming advisory will be posted.

Vulnerable beaches

George Wyth's weekly sample was 1,100, exceeding the one-time maximum of 235. Because George Wyth was on the vulnerable list, a swimming advisory was posted right away.

Less vulnerable beaches

Lake Geode had an *E. coli* count of 460 and the beach at Lacey-Keosauqua had a count of 260. Both of these counts exceeded the one-time maximum standard of 235, but because neither beach had a history of bacteria problems, swimming advisories were not posted. If the one-time standard was exceeded again the next week, an advisory would have been posted.

High geometric means

Beed's Lake showed a sample of 90, below the one-time maximum of 235. However, a swimming advisory remained in place there because the geometric mean (five samples over a 30-day period) exceeded 126, the geometric mean standard.

Causes

For this particular week, many samples were high because of widespread rainfall over Iowa, which likely elevated bacteria levels. For more information on what causes high results, please see page 6.

What causes high results?

How common are swimming advisories?
Beaches are safe for swimming most of the time. Over four swimming seasons in Iowa (2000-2003), state-owned beaches exceeded the **geometric mean standard** only 3.38 percent of the time and exceeded the **one-time standard** only 5.34 percent of the time.

What causes bacteria levels to go high?
Bacteria levels at Iowa beaches can change quickly — high one day, low the next day, or vice versa. Generally, bacteria levels tend to rise after a rainfall, as runoff from rain drains into a water body, carrying bacteria from surrounding areas.

The rain itself does not cause high results, but the rain washes bacteria from surrounding areas into the lake, river or stream. Because of this, swimming is generally not recommended in a natural body of water for 24 to 48 hours after a rainfall.

Rain events can cause one-time high bacteria readings, which are not a large cause of alarm. When there is a high geometric mean (calculated using at least five samples equally spaced over a 30-day period), it can signal a chronic problem.

What lowers bacteria levels?
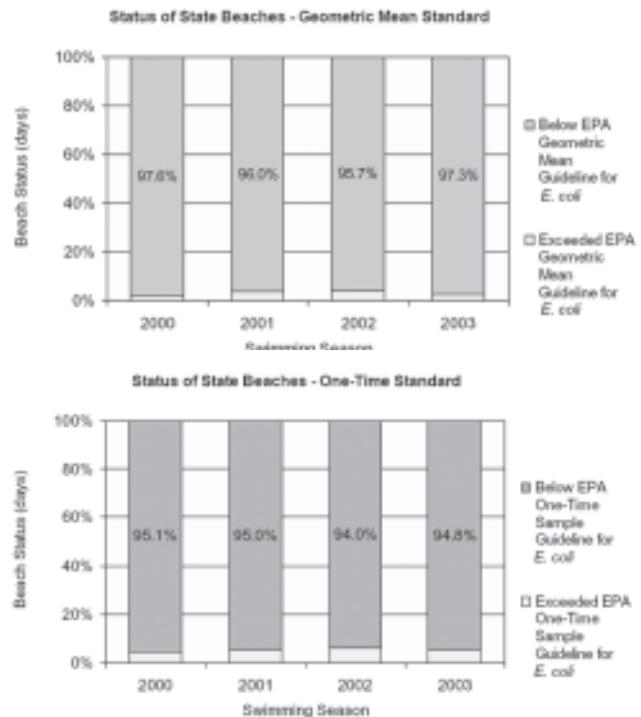With sunny conditions, bacteria begin to die off and levels can return to normal in less than two days.

What's being done to identify sources of high bacteria levels?
Generally, several sources in the surrounding environment cause high bacteria levels, making the cause of chronically high results difficult to detect.

Beaches with chronic high bacteria levels are often the subjects of an intensive watershed investigation by the DNR. The investigation takes frequent water samples from not only the affected body of water, but from points throughout the **watershed** (the surrounding area of land that drains into the body of water). The results of these investigations allow local citizens and officials to take action in improving their beach's water quality.

As part of these investigations, the DNR is beginning to use DNA fingerprinting methods to determine the cause of high bacteria levels. A current source-tracking investigation at Lake Darling in southeastern Iowa is one of the first projects to use the method.

With the DNA fingerprinting method, or **ribotyping**, bacteria from a number of known fecal sources (like deer, geese, humans, etc.) from the Lake Darling watershed will be DNA typed and used to create a library. Unknown bacteria from the lake, beach and streams in the watershed will be compared to the fecal samples in the library. By matching the unknown bacteria with known bacteria samples, researchers hope to find the cause of bacteria contamination. Once the source of contamination is identified, work can begin on improving water quality.

Status of State Beaches - Geometric Mean Standard

Beach Status (days)

2000	2001	2002	2003
97.6%	96.0%	95.7%	97.3%

☐ Below EPA Geometric Mean Guideline for *E. coli*

☐ Exceeded EPA Geometric Mean Guideline for *E. coli*

Swimming Season

Status of State Beaches - One-Time Standard

Beach Status (days)

2000	2001	2002	2003
95.1%	95.0%	94.0%	94.8%

☐ Below EPA One-Time Sample Guideline for *E. coli*

☐ Exceeded EPA One-Time Sample Guideline for *E. coli*

Swimming Season

What a swimming advisory *really* means

A swimming advisory does *not* close the beach.
Elevated bacteria levels do not mean that the beach is closed. Instead, beaches with elevated bacteria levels are posted with a "swimming is not recommended" sign. People can still enjoy volleyball, sunbathing and other beach activities.

Not every beach in the state is monitored or posts advisory signs.
When a state park swimming area is posted with an advisory sign, some people may decide to swim at another nearby area that does not monitor its water or post advisories. It is possible that bacteria levels there may also be elevated if it has rained within the last 24 to 48 hours.

Many high bacteria levels in Iowa come after rainfall, when bacteria from areas surrounding the waterbody are rinsed with runoff into the lake, pond or river. (Please see page 6, "What causes high results," for more information.)

Fish from beaches with advisories are still safe to eat.
Anglers can continue to fish even when bacteria levels are high. A fish's skin and scales protect it from the contaminants that are tested for in beach monitoring, keeping the fish safe to eat.

"The bacteria are not found in fish flesh," said Marion Conover, head of the DNR fisheries bureau. "If there were bacteria, cooking the fish would kill it. Properly cleaning and cooking the fish, no matter where it was caught, is always important."

Waders, however, should avoid the water if they have open sores or wounds exposed to the water.

State parks offer a number of activities other than swimming.
"When some people hear or see that a beach is posted, their first thought is to cancel their trip to the park," said Sherry Arntzen, an executive officer with the DNR state parks bureau. "We encourage people to think about other activities, like hiking, birdwatching, boating or fishing, and to use common sense when deciding whether or not to swim."

There are ways to avoid illness at the beach.
Even when swimming is recommended, swimmers should always be cautious and follow these guidelines to minimize the risk of disease being transmitted from swimming at a beach:
· Do not swallow the water
· Wash hands after using the restroom and after changing diapers
· Keep children in clean diapers and change diapers in the restroom
· Do not swim if you have or have recently had diarrhea

Beaches can be closed in case of an emergency health risk.
Beaches can be closed by the DNR in the event of a documented health risk, such as a wastewater bypass, hazardous chemical spill or a localized outbreak of an infectious disease.

Differences between beaches

What beaches are included in the DNR monitoring program?
All 37 state-owned beaches are monitored. Beginning in 2004, 35 of Iowa's 58 county-run beaches will also participate in the program.

County beaches are participating on a volunteer basis, and county workers will be trained to take weekly samples. Sampling results will be posted weekly along with state park monitoring results at www.iowadnr.com/news/beach.html, but *counties will decide independently* whether or not to post swimming advisory signs at their beaches.

Please see page 9 for a full listing of participating county beaches.

What's a "vulnerable" beach?
State-owned beaches are added to the "vulnerable" list after one swimming season with a high geometric mean. Beaches can be removed from this list after two swimming seasons without a high geometric mean. Beaches on the 2004 vulnerable list include:

Backbone Lake	George Wyth	Rock Creek	Geode	Prairie Rose
Clear Lake	Lake of Three Fires	Beed's Lake	Lake Darling	Union Grove

What's a "less vulnerable" beach?
State-owned beaches not included on the "vulnerable" list are included in this category. Swimming advisories are posted at these beaches only when the one-time maximum standard for *E. coli* is exceeded for two consecutive weeks or if the beach has a high geometric mean.

Are there any beaches that are monitored less?
State-owned beaches that have had one or less one-time highs in the last four years will be monitored weekly from the week before Memorial Day to Labor Day. All other state-owned beaches will be monitored from May 24 to Oct. 31.

The beach at Lake Keomah in Mahaska County.

Beaches to be monitored from the week before Memorial Day to Labor Day, 2004, include:

Black Hawk	Green Valley	Lake Ahquabi	Lake Macbride	Pleasant Creek
Blue Lake	Gull Point	Lake Anita	Lake Manawa	Red Haw
Brushy Creek	Lacey-Keosauqua	Lake Keomah	McIntosh Woods	Triboji

Beach illnesses

"Since the illnesses associated with the use of bathing beaches can also be caused by food, drinking water and contact with sick persons, it is usually not possible to say that one person got sick because he or she went swimming at a beach.

"If several people become ill within a short time with similar symptoms (an outbreak), a common cause can often be found.

"No outbreak has ever been associated with a state-operated beach in Iowa."

-- Michael Magnant
Iowa Department of Public Health

What's next

A number of beach monitoring research opportunities lie on the horizon, including more intensive watershed investigations and more work with the DNA fingerprinting method to determine causes of high bacteria levels.

The DNR is also partnering with the University of Iowa Center for Health Effects of Environmental Contamination (CHEEC) and the Department of Epidemiology in the UI College of Public Health on a pilot epidemiological study looking at illnesses that occur at the beach.

The DNR also hopes that more county- and city-run beaches express interest in participating in the DNR's water monitoring efforts.

County beaches monitoring in 2004

Airport Lake	Chickasaw County
Ashton Park	Osceola County
Belva-Deer Recreation Area	Keokuk County
Bobwhite State Park	Wayne County
Briggs Woods Park & Golf Course	Hamilton County
Central Park	Jones County
Cold Springs Park	Cass County
Crystal Lake Park	Hancock County
Don Williams Park	Boone County
Easter Lake Park	Polk County
Eldred-Sherwood Recreation Area	Hancock County
Gabrielson Park	Buena Vista County
Hickory Grove Park	Story County
Hillview Recreation Area	Plymouth County
Lake Cornelia Park	Wright County
Lake Icaria Recreation Area	Adams County
Lake Iowa Park	Iowa County
Lake Pahoja Recreation Area	Lyon County
Little River Recreation Area	Decatur County
Littlefield Recreation Area	Audubon County
Lost Island - Huston Park	Palo Alto County
Meredith Park	Pocahontas County
Nelson Park	Crawford County
Ocheyedan Pits Recreation Area	Osceola County
Oldham Recreation Area	Monona County
Orleans Beach Area	Dickinson County
Peterson Park	Story County
Pollmiller Park	Lee County
Split Rock Park	Chickasaw County
Spring Lake Park	Greene County
Swan Lake State Park	Carroll County
Treman Park	Calhoun County
West Lake	Scott County
Willow Lake Recreation Area	Harrison County
Yellow Smoke Park	Crawford County

County beaches will sample from the week of May 31 through September 6. Sampling results are posted weekly with state park monitoring results at www.iowadnr.com/news/beach.html. Counties will decide independently whether or not to post swimming advisory signs at their beaches.

2004 DNR Beach Policy

This policy includes only state-owned beaches.

Beaches will be posted with a "Swimming is Not Recommended" sign if:

- The geometric mean exceeds the water quality standard (five samples in a 30-day period exceeds 126 colony forming units of *E. coli* bacteria per 100 ml of water)

- The beach is classified as "vulnerable" (see list below) and one sample exceeds Iowa's one-time maximum standard (235 colony forming units of *E. coli* bacteria per 100 ml of water)

- The beach is classified as "less vulnerable" and two weekly samples exceed the one-time water quality maximum standard (235 colony forming units of *E. coli* bacteria per 100 ml of water)

Beaches that have had one or fewer exceedances of the state standard in the last four years running will be monitored less frequently. These beaches will be monitored on a weekly basis from the week before Memorial Day through Labor Day.

Beaches that will be monitored less frequently include:

- Black Hawk
- Blue Lake
- Brushy Creek
- Green Valley
- Gull Point
- Lacey-Keosauqua
- Lake Ahquabi
- Lake Anita
- Lake Keomah
- Lake MacBride
- Lake Manawa
- McIntosh Woods
- Pleasant Creek
- Red Haw
- Triboji

All other state-owned beaches would normally be monitored from April 15 through October 31, however due to budget constraints, these beaches will be monitored the week before Memorial Day through October 31.

Beaches in the vulnerable category include:

- Backbone Lake
- Beed's Lake
- Clear Lake
- Geode
- George Wyth
- Lake Darling
- Lake of Three Fires
- Prairie Rose
- Rock Creek
- Union Grove

DNR reserves the right to close a beach in the event of a documented health risk including things such as (but not limited to) wastewater bypass, spills of hazardous chemicals, or localized outbreaks of an infectious disease.

Glossary of common terms

fecal indicator bacteria
Bacteria that are normally not pathogenic (disease-causing) but that serve as indicators that fecal matter may be present.

geometric mean
A type of average that is calculated using a formula developed by the U.S. Environmental Protection Agency of five water samples, equally spaced over a 30-day period.

$$\text{Geometric Mean} = \sqrt[5]{x_1 * x_2 * x_3 * x_4 * x_5}$$
where x is a single bacteria result

geometric mean standard
126 colony-forming units of *E. coli* bacteria per 100 milliliters (mL) of water. State-owned beaches that exceed this post swimming advisories.

indicator bacteria
Bacteria that normally are not pathogenic (disease-causing) but serve as indicators of certain types of pollution such as sewage or gasoline spills.

Escherichia coli (*E. coli*)
A type of coliform bacteria present in the gastrointestinal tract of warm-blooded animals. The concentration of *E. coli* bacteria is an indicator of the probability of contamination of surface water by microbial pathogens. Reported in Colony Forming Units/100 mL of sample (CFU/100 mL).

less vulnerable beach
Most Iowa state park beaches fall in this category. Beaches are placed in this category if they are not deemed a "vulnerable" beach. Less vulnerable beaches post swimming advisories only if the one-time maximum standard is exceeded for two consecutive weeks or if the beach has a high geometric mean.

one-time maximum standard
235 colony-forming units of *E. coli* bacteria per 100 milliliters (mL) of water. "Vulnerable" state-owned beaches must post swimming advisories whenever this standard is exceeded; "less vulnerable" beaches must post advisories if this standard is exceeded for two consecutive weeks.

pathogens
Microorganisms, like bacteria or viruses, that can cause disease in humans, animals and plants.

ribotyping
A DNA fingerprinting method where bacteria from known fecal sources are compared to unknown bacteria to determine the cause of bacteria contamination.

vulnerable beach
State park beaches are placed in this category after one swimming season with a high geometric mean. Beaches can be removed from this list after two swimming seasons without a high geometric mean.

watershed
An area of land that drains into a body of water, like a stream, lake or marsh. Watersheds can be as small as a city block, draining into a creek, or very large (two-thirds of Iowa is part of the Mississippi River watershed).

For more information

Contact the following people for more information on beach monitoring and beach results:

Monitoring results
Janice Boekhoff
Research biologist
DNR Water Monitoring section
(319) 335-1575
jboekhoff@igsb.uiowa.edu

To receive weekly press releases on beach monitoring results, please contact:
Jessie Rolph
DNR Information Specialist
(515) 281-5131
Jessie.Rolph@dnr.state.ia.us

State parks
Sherry Arntzen
Executive officer, DNR State Parks bureau
(515) 242-6233
Sherry.Arntzen@dnr.state.ia.us

To contact a specific state park directly by phone or e-mail,
a directory is available at:
www.state.ia.us/dnr/organiza/ppd/alias.htm

If you suspect that you may have contracted a waterborne illness, contact:
1. Your local county public health office
2. The Iowa Department of Public Health at (515) 281-4941

For more water monitoring information:
Weekly beach monitoring results
www.iowadnr.com/news/beach.html

DNR Water Monitoring Section
http://wqm.igsb.uiowa.edu

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www.iowadnr.com